Coherent electron Cooling (CeC)
PoP experiment

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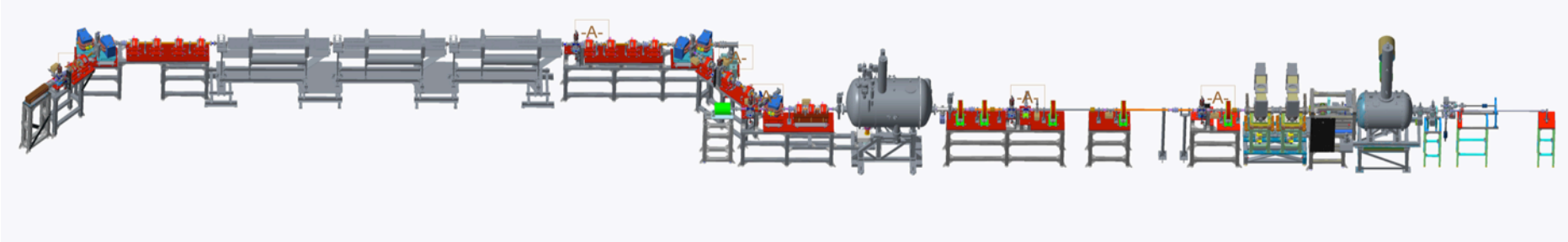
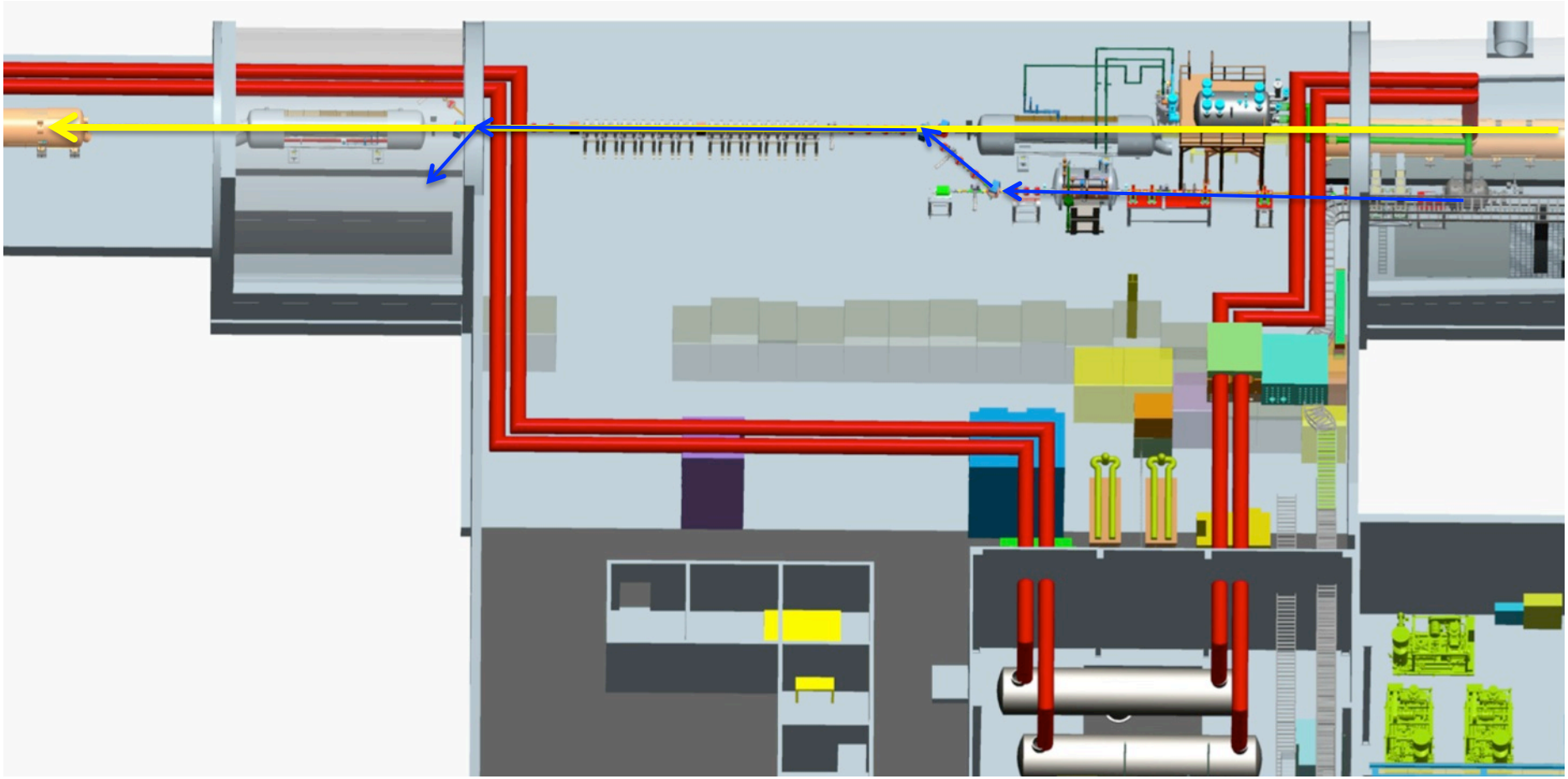


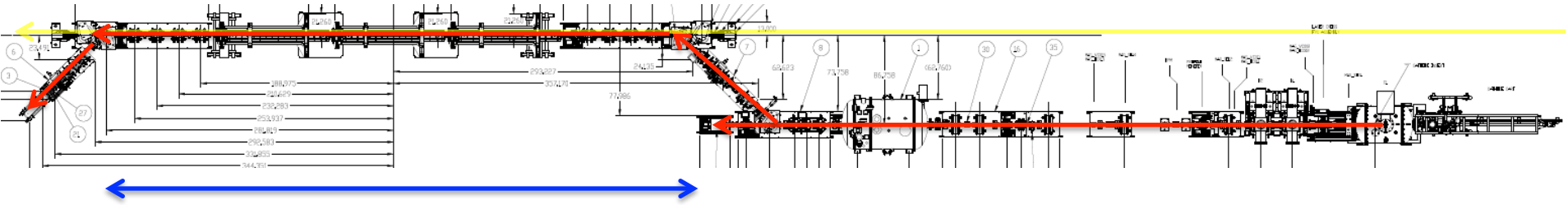
ARR March 1, 2016

CeC Proof-of-Principle Experiment

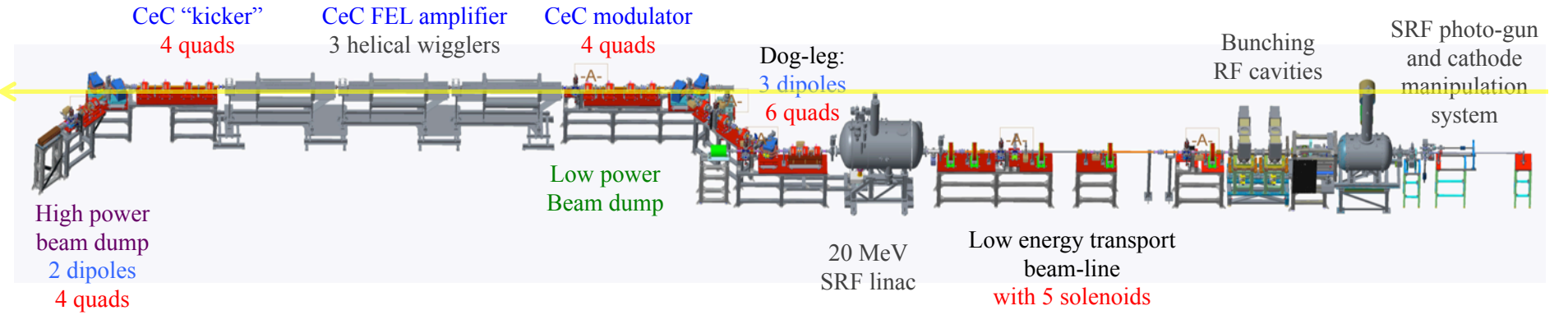


Coherent electron *Cooling* PoP

The CeC system



Common section with RHIC



Main Beam Parameters for CeC Experiment

Parameter	Value	
Species in RHIC	Au^{+79} ions, 40 GeV/u	*v*
Relativistic factor	42.96	*v*
Number of particles in bucket	10^9	*v*
Electron energy	21.95 MeV	< 10 MeV
Charge per e-bunch	0.5-5 nC	4.6 *v*
Rep-rate	78.17 kHz	Plan to attain
e-beam current	0.39 mA	Plan to attain
Electron beam power	8.6 kW	Plan few kW

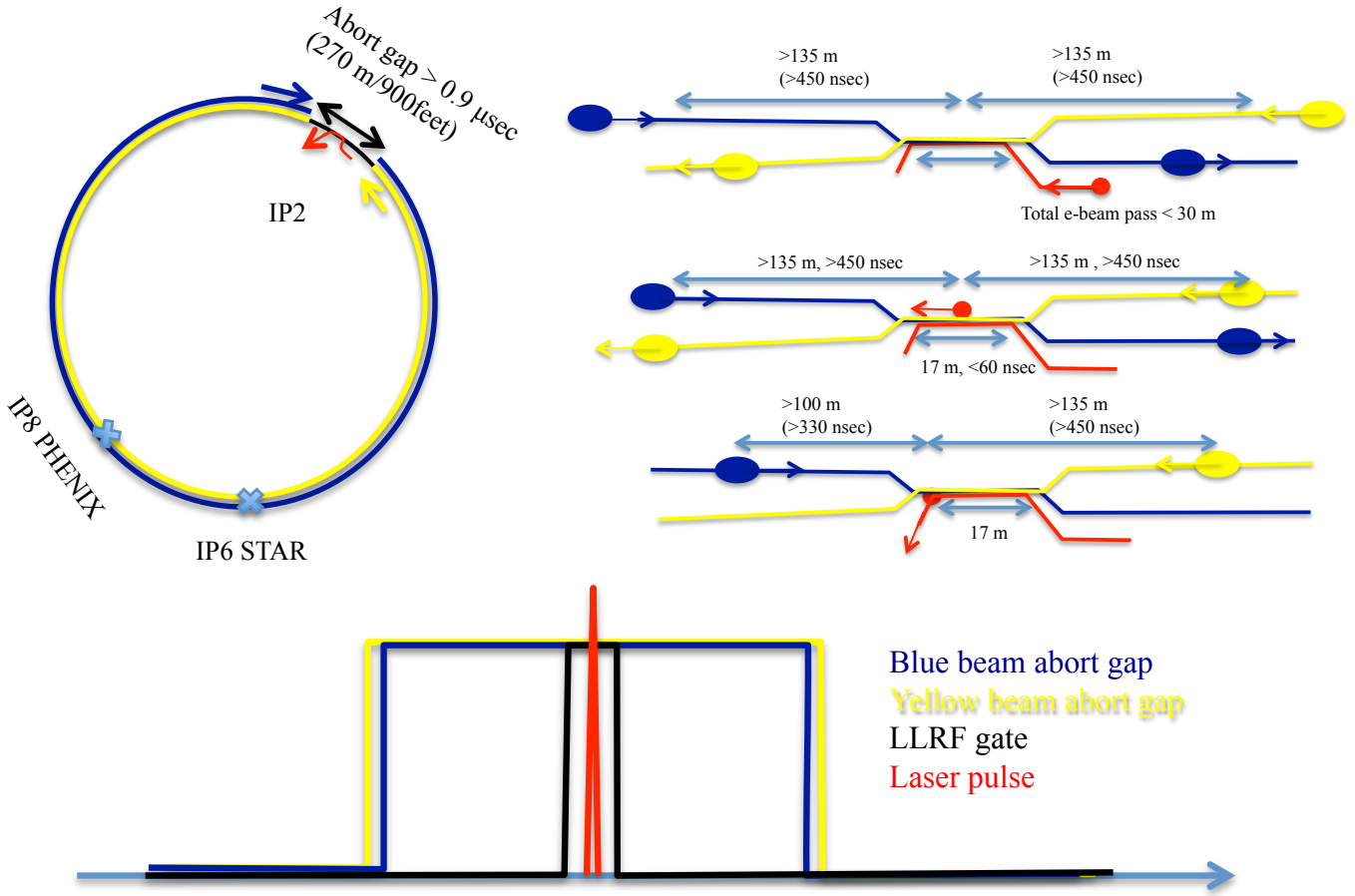
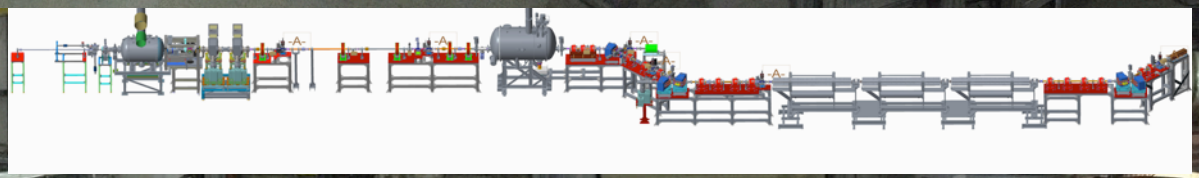


Figure 3 In RHIC, colliding hadron beams have an abort gap that is typically 1 microsecond long but always longer than 0.9 microseconds. By design, these abort gaps always overlap at IP8 and IP2. It provides a long period when there are zero hadrons in the 19-m long straight section common for yellow and blue hadron beam and CeC's electron beam. CeC Pop Experiment will use 200 nsec of this gap to propagate electron beam in the common section. The gate window for this propagation will be opened by the RHIC/CeC low-level RF system.

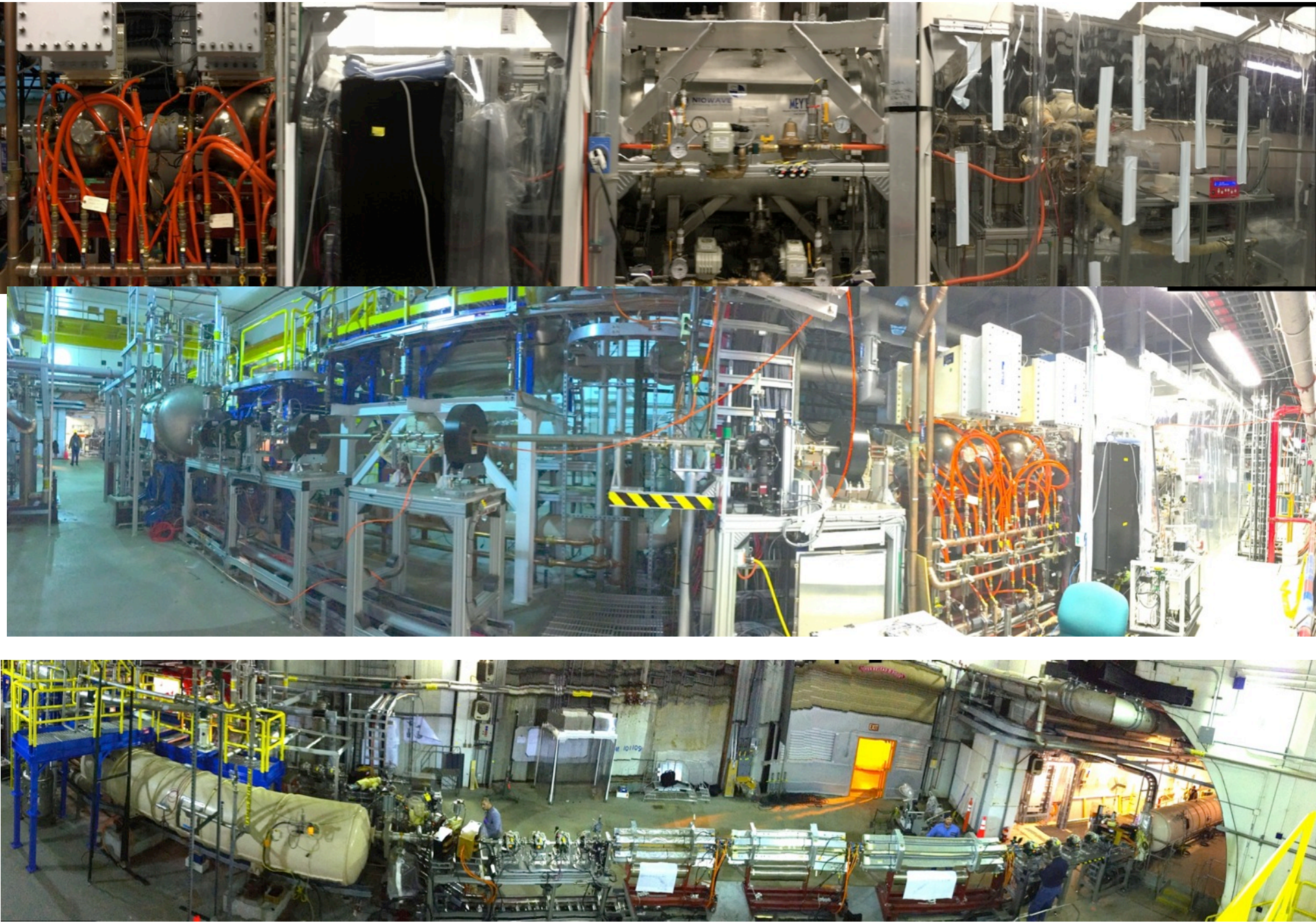
Panoramic views

From inside RHIC ring



From outside RHIC ring

Panoramic views

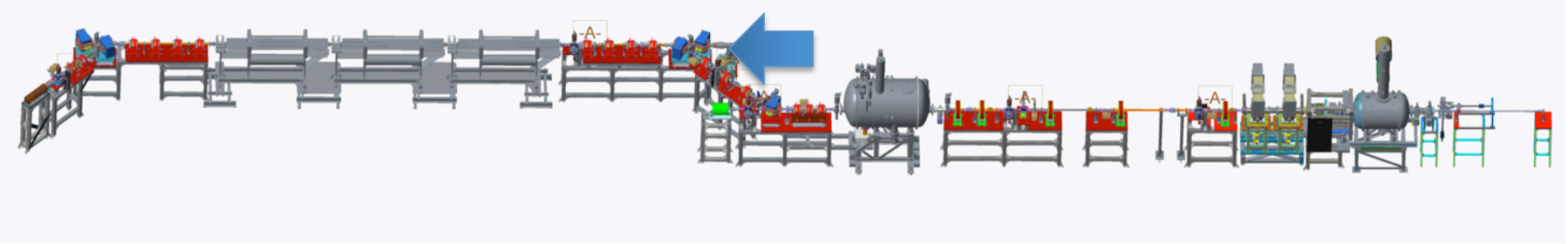


Main steps for CeC

0. Finish installation of CeC PoP system into IP2
1. Developing RHIC ramp with proper beam envelope (beta*) in IP2
2. Developing RHIC ramp for CeC PoP experiment
3. CeC ARR
4. Conditioning of CeC RF system (112 MHz, 500 MHz & 704 MHz): design voltage, synchronized to RHIC beam, full control of voltage and phase
5. Re-commission the SRF gun, 500 MHz bunching cavities and accelerate beam to 20 MeV and beam power < 1W
    1. 704 MHz SRF linac is contaminated and accelerating voltage is limited to 10 MV in PLL mode and **to 5-6 MV in IQ mode, which is REQUIRED for operating beam**
6. Measure beam parameters (charge, emittance, peak current, energy spread…)
7. Increase beam power 10x. follow by radiation surveys (and fault studies <10 W)
8. Propagate full power 20 MeV e-beam to the beam dump, match the beam into FEL
9. Commission IR FEL diagnostics and demonstrate FEL amplification
10. Co-propagate, align and synchronize electron and ion beams
11. Match relativistic factors (velocities) of hadron and electron beams
12. Observe amplification of the density modulation
13. Attempt to observe local cooling

Where are we at the moment?

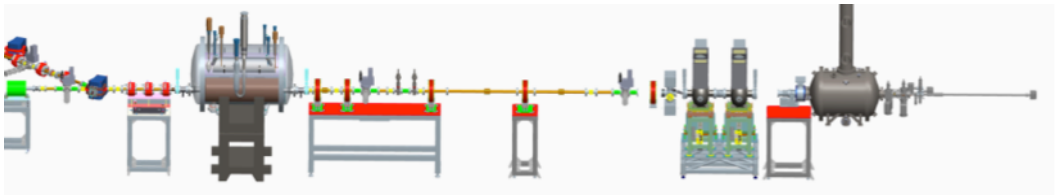
- ✓ SRF gun is operational at 1.15 MV CW , cathodes are available, laser is operational, designed charge per bunch can achieved
- ✓ 500 MHz RF bunching RF cavities are fully operational and synched with SRF gun
- ✓ Most of the beam diagnostics is working, beam is propagated to the entrance to the common section



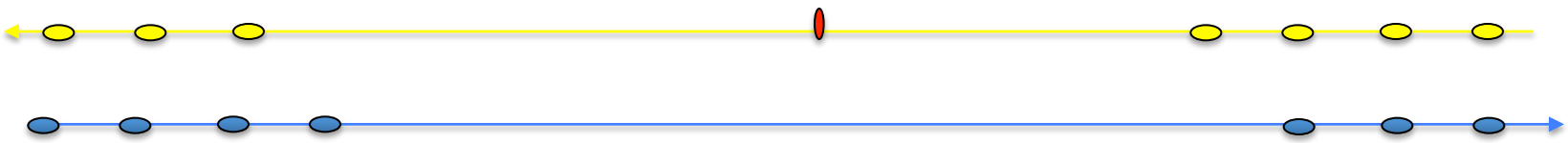
- ✓ "20 MeV" 744 MHz SRF linac has major problems. It can generate about 10 MV in stand along mode, but only ~ 5-6 MV when synched to the gun
- ✓ This energy is sufficient to propagate full current beam to the full power beam dump, but not for CeC commissioning

How we will operate

- Commissioning of CeC accelerator
  - Parallel to RHIC operation, except occasional requests for access



- Propagating electron beam through the IP2 to the dump
- Parallel to RHIC operation: electron bunches passing through the IP2 during Blue abort gap and between 2 yellow bunches



Conclusions

- ✓ Shortcomings of SRF linac energy does not allow us to attempt full scale commissioning of CeC.
- ✓ Still, we want to continue commissioning of the CeC accelerator and its systems (diagnostics, software, MPS…). **Most of this commissioning can be done in parallel with normal RHIC collider operation.**
- ✓ Instead of 1 week of dedicated RHIC, we are asking for total up to 24 hours of either dedicated test (such as radiation surveys) or IP2 access to troubleshooting and maintenance.